

This work is licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike License](https://creativecommons.org/licenses/by-nc-sa/4.0/). Your use of this material constitutes acceptance of that license and the conditions of use of materials on this site.



Copyright 2006 Adnan Hyder, Maria Segui-Gomez, and The Johns Hopkins University. All rights reserved. Use of these materials permitted only in accordance with license rights granted. Materials provided "AS IS"; no representations or warranties provided. User assumes all responsibility for use, and all liability related thereto, and must independently review all materials for accuracy and efficacy. May contain materials owned by others. User is responsible for obtaining permissions for use from third parties as needed.



JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Evaluation

Adnan Hyder, MD, PhD

Maria Segui-Gomez, MD, ScD

Bloomberg School of Public Health



JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Section A

*Methodological Issues Related to
Evaluation—A Focus on Effectiveness,
Part I*


Maria Segui-Gomez, MD, ScD

Determining Quality of Evidence

- ◆ Was this the right study design?
- ◆ Types of studies (need a similar group acting as control):
 - Case-control (case cross-over)
 - Cohort
 - Experimental
 - Quasi-experimental
- ◆ Did they use the right outcome variable(s)?
- ◆ Did they use the right analytical tools?

On Variables and Analyses

Selecting Variables

- ◆ Types of variables 
- ◆ Frequently used variables
 - Outcomes
 - Exploratory
 - Confounders, etc . . .

Selecting Analysis

- ◆ Univariate
- ◆ Bivariate
- ◆ Multivariate
 - Regression Models
 - (ANOVA)
 - (Time series)

Types of Variables

- ◆ Nature
 - Categorical (e.g., pedestrian, driver, passenger)
 - Ordinal (e.g., injury severity [ISS])
 - Interval (e.g., proportion SB use)

Types of Variables

- ◆ Absolute numbers
 - With intrinsic meaning (e.g., number of deaths)
 - With assigned meaning (e.g., ISS)

Types of Variables

◆ Ratios

- Proportions ($x_1 / x_1 + x_2$)
(e.g., 0.68 SB users)
- Percents ($100 * x_1 / x_1 + x_2$)
(e.g., 68% SB use)
- Rates (x / y)
(e.g., 435 deaths per 100,000 VMT)

Choosing Your Outcome

An Example: Child Passenger Seating Position

<i>N (%)</i>	Frankfurt	Brussels	Paris	Boston	New Orleans
Children in front	89 (10)	123 (22)	219 (9)	280 (25)	302 (27)
Vehicles with at least one child in front	90 (14)	212 (32)	129 (14)	272 (35)	283 (38)

Analysis: Interval Data

I. Univariate Analysis (descriptive)

- ◆ Mean, median, mode
- ◆ Need for confidence intervals (if sample)

Analysis: Interval Data

- ◆ For example:
- ◆ ISS among drivers in frontal crashes (n = 5003) (Note ISS range: 0–75)
 - Mean 6.4
 - St. Dv. 15.6
 - Range 0–75
 - Median 1; quartiles 0 / 0 / 1 / 4 / 75; mode 0

Analysis: Interval Data

II. Bivariate Analysis

- ◆ If outcome is interval and other is categorical or ordinal: Compare means (e.g., T student)
- ◆ If outcome and other variables are intervals: Correlation (e.g., Spearman rho)
- ◆ Linear regression (with only one independent variable)

Analysis: Interval Data

III. Multivariate Models

- ◆ Linear regression models
- ◆ Regardless of type, if outcome has:
 - Normal distribution: Normal regression
 - Poisson distribution: Poisson regression

Analysis: Interval Data

- ◆ Interpretation: One unit change in any independent is associated with a mean (x units) change in dependent (y)



JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Section B

*Methodological Issues Related to
Evaluation—A Focus on Effectiveness,
Part II*

Maria Segui-Gomez, MD, ScD

Analysis: Ordinal / Categorical

I. Univariate Analysis (descriptive)

- ◆ Frequency counts
- ◆ Needed for confidence intervals (if sample)

Analysis: Ordinal / Categorical

II. Bivariate Analysis

- ◆ Comparison of proportions (e.g., Chi square)
- ◆ (Ordinal, multinomial) logistic regression with only one independent variable
- ◆ Intra-class correlation coefficient

Analysis: Ordinal / Categorical

III. Multivariate Analysis

- ◆ Regression models
 - If outcome is ordinal: Ordinal logistic
 - If outcome is categorical:
 - If several categories: Multinomial (polytomous) logistic
 - If two categories: Logistic

Analysis: Ordinal / Categorical

- ◆ Issues on ordinal regression models
 - Outcome has ordinal properties
 - Interpretation: One unit change in any independent variable is associated with x change in probability of y category to happen



JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Section C

Evaluation Case Study

Maria Segui-Gomez, MD, ScD

The Paper at Hand

- ◆ Objective is to assess the impact of introducing or lowering *per se* limits in Blood Alcohol Concentration (BAC) levels in reducing motor vehicle-related injuries
- ◆ Literature review of large number of papers published up to 2000
- ◆ Information on numerators (outcomes), denominators (exposure), confounders (if any), study designs, analysis, and results

The Goal of this Case Study Is to Emphasize the Need to:

- ◆ Investigate the reported evidence on a particular injury prevention intervention
- ◆ Methodically, go through the following steps:
 - Understand what intervention is under evaluation
 - Understand the choices of numerators
 - Understand the choices of denominators
 - Understand the choices of analysis
 - Understand the underlying study designs

What Intervention(s)?

- ◆ Define the intervention under evaluation (target population, nature of the intervention, degree of divulgation, enforcement (if any), etc . . .)
 - Too often this is not properly explained, which makes comparisons across “similar” interventions difficult

Analyzing the Evidence*: Choices of Numerators

- ◆ Events
 - Of different severity
- ◆ Injured individuals
 - With different severities
- ◆ Injuries
 - Of different severity

Analyzing the Evidence: Choices of Numerators

- ◆ Type of Numerator
 - Only one (e.g., nighttime fatal collisions)
 - Several—do several analyses (e.g., nighttime fatal collisions and proportion of intoxicated fatally injured drivers)
 - Several—integrate in an “index” (although no such measure was used in the review under evaluation)

What Would Work Best?

More Appropriate



Less Appropriate

- ◆ Direct measure
 - Roadside surveys of BAC levels
 - Collisions with drivers with BAC higher than limit
- ◆ Indirect or “proxy” measures
 - BAC levels among fatal drivers
 - Fatal drivers
 - Nighttime fatal crashes, weekend fatal collisions

Analyzing the Evidence: Choices of Denominators

- ◆ Exposure
 - Alcohol consumption (more or less?)
 - Time between drinking and driving (more or less?)
- ◆ Confounders
 - Total amount of driving (more or less?)
 - Total amount of drivers
 - Other safety measures (e.g., safety belt)

What Would Work Best?

More Appropriate



Less Appropriate

- ◆ Population of reference
- ◆ That affected by population
- ◆ Some generic or undifferentiated population

What Would Work Best?

More Appropriate



Less Appropriate

- ◆ Co-variates included:
- ◆ Control by changes in host, agent, and environment-related factors and/ or changes in pre- event / event / post-event
 - Changes in risk of crash
 - Changes in risk of injury and or more severe injuries (e.g., safety belt)
 - Changes in risk of sequelae (e.g., EMS, acute care)
- ◆ Nothing

Analyzing the Evidence: Study Designs

- ◆ Simple pre- and post-comparisons
- ◆ Pre-post comparisons with external control
- ◆ Pre- and post-comparisons controlling for confounders and external controls
- ◆ What do we define as “post”
 - Length of follow up

What Would Work Best?

More Appropriate



Less Appropriate

Follow-up time

- ◆ Long

- ◆ Short, e.g. right after intervention

What Would Work Best?

More Appropriate



Less Appropriate

Analysis Level

- ◆ Individual level
- ◆ Population level (Ecological)

What Would Work Best?

More Appropriate



Less Appropriate

Study Design

- ◆ (Same subject all interventions)
- ◆ Experimental
- ◆ Quasi-experimental
- ◆ Cohort
- ◆ Case control
- ◆ Cross-sectional
- ◆ Case series
- ◆ Case report

Analyzing the Evidence: Analytical Choices

- ◆ Frequency (or proportions) of cases
- ◆ Statistical comparisons of proportions
- ◆ Statistical comparisons of proportions while controlling for confounders
- ◆ Statistical comparisons of more than two proportions (e.g., time series)

In This Particular Review

- ◆ Pre-post comparisons
- ◆ Time series analysis
- ◆ Weighted least squares regression analysis (suggest control by confounders, but how many, how well?)
- ◆ Need to understand what researchers did

Evaluating Injury Prevention Interventions

- ◆ No different than any other evaluation (need good Epidemiology and Biostatistics!)
- ◆ Take particular care on how to identify/count numerator:
 - Including how to deal with multiple injuries/multiple events
 - How to identify denominator and/or exposure

Evaluating Injury Prevention Interventions

- ◆ Take particular care on how to define intervention:
 - Including the fact that many injury interventions are “bundled” together
 - And how to handle the repetitive nature of some interventions (e.g., use of helmet every time one rides)
- ◆ How to handle the length of time needed to judge the intervention as effective

Putting It All Together . . .

- ◆ In the discussion:
 - Look for realistic and objective statements based on reported results

Discussion

- ◆ “In most, but not all cases [...], some beneficial effect on traffic safety has been reported. These effects are in some cases relatively small and in [others] temporary. Available evidence suggests that where beneficial effects are observed they are due to general deterrence and not limited only to drivers with the BAC levels specifically affected by legal change.”

For More Information on Systematic Reviews

- ◆ American Journal of Preventive Medicine special issues
- ◆ Cochrane collaboration

The (Unfortunately Common) Reality on Evaluation . . .

- ◆ “First, we collect interventions. Everyone who has an idea can call it a safety measure. Psychologists contribute educational interventions and campaigning, lawyers enforcement measures, engineers road construction, etc . . .”

The (Unfortunately Common) Reality on Evaluation . . .

- ◆ “Then, the number of fatalities and injuries that can be prevented with these measures is being estimated (estimated guesses are multiplied with four other estimated guesses, which leads to well estimated guesses). Sometimes, we do it the other way around: How many fatalities do we believe can be prevented with this intervention? How large should be the educated guess to come to the favored result? [...]”

. . . And Program Selection

- ◆ “And the costs are being (guess what) estimated”
- ◆ “This is about as far as we have come. I am looking forward to what will happen next. I guess that one type of guess will be divided by the other to conclude which measures have the best cost-benefit ratio.”